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ABSTRACT

The first (exploratory) phase of the Learning in Science Project focused on science teaching/learning in the Form 1 to 4 level (ages 10 to 14) and sought to identify problems and difficulties in several areas. Provided in this paper are comments obtained during structured/unstructured interviews (from students, ex-students, teachers, headmasters, science advisers, and inspectors) and observations made by project staff related to the classroom teacher. The intent in presenting these comments/observations is not primarily to provide a balanced view of good and bad aspects for Form 1 to 4 science, but rather to open up problem issues as project staff and others see them. Comments/observations focus on: teacher role in science instruction; knowledge, attributes, and sensitivities teachers need to teach science; pre-service teacher education; and support available for teachers so they can overcome problems and increase their effectiveness. Each of these areas is addressed in separate sections, followed by a discussion of two central issues, both of which could be alleviated without great manpower or financial input. The first concerns effective use of human resources/expertise; the second concerns whether or not enough attention is given to finding possible ways of encouraging professional development through sharing of teaching experiences. (JN)

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LEARNING IN SCIENCE PROJECT

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FOCUS ON THE TEACHER

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University of Waikato
Hamilton, N.Z.

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WORKING PAPER No 5

The Learning in Science Project is an educational research project undertaken at the University of Waikato under contract to the NZ Department of Education. The project is initially investigating the problems and difficulties of Form 1 - 4 Science (10 - 14 year olds) as a first step to improving teaching and learning.

This paper is one of a set of essays which is an outcome of the exploratory phase of the project. It is our hope that feedback from these essays will assist further to clarify issues and assist us in establishing priorities for the in-depth phase of the project. Any comments our readers have on either the issues involved, or the methodology adopted in these papers, would be most welcome.

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FOCUS ON THE TEACHER

A WORKING PAPER OF THE LEARNING IN SCIENCE PROJECT
Roger Osborne, Peter Freyberg and Ross Tasker
September 1979

This is one of a set of discussion papers which focus on various aspects of Form 1-4 Science. The paper collates comments and observations, related to the topic of focus, which were obtained during the first phase of the Learning in Science Project. In this phase we were particularly concerned about problems and difficulties in Form 1-4 Science and because of this the paper is biassed toward issues as identified by pupils, ex-pupils, teachers, headmasters, science advisers, inspectors as well as by our own observers. Our intention in writing the discussion papers is therefore not primarily to provide a balanced view of the good and bad aspects of Form 1-4 Science but rather to open up problem issues as we and others see them, to a limited but wider audience than the project team.

It is our hope that our chosen readers will be prepared to talk to us about the topic under focus in this paper in terms of the following questions:

(i) Are the issues we have raised important and central issues which are of general concern?

(ii) Are there other more basic issues, or other subsidiary questions, about the topic which we have overlooked?

(iii) Which aspects of the topic could we profitably analyze further in the in-depth phase of the project?

(iv) What possible solutions to some of the issues raised could profitably be the subject of further study?

INTRODUCTION

Many of the FOCUS working papers deal with specific aspects of the teaching and learning activities in science classrooms. This paper along with FOCUS ON THE LEARNER, is specifically concerned with the participants in the teaching-learning situation.

12/1/2[1]
43/3/1
43/11/3

Many people we have interviewed, particularly pupils and ex-pupils, consider the teacher is an all important factor in learning and enjoying science.

7/8/2

> "(what are your memories of science?) oh it was all right ... but then it depends on your teachers in a way (can you remember your first science lesson?) I was looking forward to meeting the teacher (were you disappointed?) no ... when I went home and told my brother he said she was a good teacher ... that was a big help."
>
> [ex-pupil]

15/6/2

> "I think a teacher can make you like or dislike the subject early on ... you know, it is how they tackle it really"
>
> [ex-pupil]

16/9/1

> "(what about science in Form 3) Oh well I reckon we had a good teacher."
>
> [ex-pupil]

The above comments support the comment made to us by an experienced teacher,

20/5/2

> "the most important thing for students (particularly of average ability) is their relationship with the teacher ... ask them what they think of science and you invariably get a comment back on what they think of the teacher."
>
> [HOD Science]

While the interviews have brought to our attention the importance of the teacher, particularly when ex-pupils review their F1-4 Science experience, it is also clear that there is sometimes a considerable difference between what the teacher is capable of doing and would like to do, on the one hand, and what actually happens, on the other.

17/15/3

> "Its frustrating as anything for a first year teacher coming out with high ideals ... it's terribly frustrating ... you want to impart your knowledge and you want to open doors and they slam it right back in your face, it is really difficult."
>
> [first year secondary teacher]

1: Tape/page/section reference to original transcript on our files.

17/27/2 "I would like to introduce topics like marine biology and to see science more socially orientated (but) I know my own limitations, I am not capable of generating a unit of work like that, especially being a first year teacher."

[first year secondary teacher]

27/4/1 "Last year I was actually going to be doing the solar system ... 'cause I thought I will have to learn something about it ... I will enjoy doing it ... but at the last minute I just couldn't find enough material so I changed (to another topic)"

[intermediate teacher]

79/3/1 "I've got all the equipment but my big problem is how to use the equipment. I am at a loss when I pick up one of those (Dept of Ed) kits and see the equipment inside it and don't know where to start or how to start."

[Std 5 & 6 primary teacher]

20/20/3 "(Teaching the chemistry and physics topics is) difficult, especially with my brighter group there were kids in that group that knew more about nuclear physics than I'd ever dreamed of ... there were questions there that I certainly couldn't answer ... With the less able too there were also problems when it comes to thinking about cars and motor bikes because they know more about that (than I) for sure ... 'cause it was their main interest."

[2nd year secondary teacher-biologist]

These teachers are aware of their problems and can, and do, express them. However teachers may well have problems which they either don't recognize or don't think important. Sometimes this is because they have no means of gauging their success or failure compared to other teachers;

83/13/3 "I have no feedback ... I have no idea of my success or failure ... I have no idea of how I am succeeding and I think that is a shame. (However) I went to a F1-4 course and I realized that a lot of kids are lucky (just) to have someone who knows science. The abysmal ignorance of some of the teachers was frightening."

[F2 teacher in a F1-7 school]

The above introduction brings out two main points. Firstly the teacher is perceived as an all important component of teaching and learning science. Secondly teachers do have problems in teaching science. While many of these problems are clear to the teachers, it is also likely that many teachers are unaware of additional problems because of the difficulty of obtaining adequate feedback on teaching effectiveness.

In this paper we hope to open discussion on some of the following questions . Are there aspects of the teachers role which are particularly important for successful teaching of science? What knowledge, attributes and sensitivities do teachers need to teach science? What training and on-going support is provided, and what is necessary, to do the job efficiently?

THE ROLE OF THE TEACHER IN SCIENCE TEACHING

Do teachers see a clear role for themselves in teaching F1-4 Science? Do teachers have clear aims? Some do,

17/8/1

> "as I see it we are going to develop attitudes ... attitudes of work which is very very important and attitudes to a particular subject ... I measure (teaching) success purely from the attitude of the pupils ... if they enjoy it ... if they like it ... if they are succeeding and gaining from it ... I think if teachers go out of their way to make sure that the work done is within the range or the capabilities of the pupils, then the interest will follow provided that they can always see the relevance of the work being done."
>
> [secondary teacher]

20/6/2

> "For the low ability kid my aims are instilling correct work habits and (developing in them) an appreciation of a few of the basic science skills and a few of the basic ideas."
>
> [HOD Science]

and some are working towards further clarification,

25/16/2

> "in this school, in the Science area anyway, people are concerned with sitting down and talking about why science is in the school, why it is part of the compulsory core in the school, or whether or not it should be, what sort of science should be taught, what the end points of the science programme should be, and so on."
>
> [HOD Science]

Associated with the aim of teaching is the role the teacher sees for himself or herself as a teacher. At least one teacher sees a clear role for himself albeit in the ideal situation,

17/5/3 "My ideal situation in the school would be coming in every day and being able to go to class... my technician has set out all the gear... I perhaps give a wee talk to the class 5 - 10 minutes on some sort of concepts ... a few questions, ... answers about revision something like that ... then say right "you know the units on ... go to it in your groups" and just leave them ... and I just walk around ... I'm a tutor or director ... an advisor to small groups ... the labs would have to be set up with all the equipment on racks and pegs."

[HOD Science]

Undoubtedly many F3 and 4 teachers are very content oriented,

6/19/2 "(Many teachers I have seen) spend a lot of time getting content together, but they don't seriously plan what they are actually going to teach"

[secondary science advisor]

34/4/2 "they had the feeling at the back of their minds that if they didn't cover the material in F3 and 4 they were going to hamstring the kids for school certificate because the material was examinable ... so they ploughed on regardless (of what the kids could cope with)."

[secondary science inspector]

Content oriented teaching often seems to be associated with exam oriented teaching,

35/4/1 "I have teacher say to me ... I don't need to do practical work ... I can get kids through exams without practical work."

[science inspector]

64/11/2 "Teachers tend to be content oriented ... School Cert is content oriented ... it all boils down to a knowledge based exam doesn't it?"

[primary school advisor]

Some F1 and 2 teachers gear themselves to teaching what they think their pupils will need further on in the education system,

25/19/2

9/3/2 "I make a big thing of (project work) in Form 2 because I know that in F3 and further on, they are going to be given this type of thing to do.

[intermediate teacher]

27/7/2 "things like 'terminal predator' for example, I think that is a particularly useless term but I taught it ... I'll tell you why I taught it because I thought well maybe next year they'll be expected to know it and it might boost their confidence a little bit if they know what a 'dominant predator' is .. so that is the sole reason that I taught it."

[intermediate teacher]

However others are more concerned with long term goals,

42/8/2

> "As far as the biology part of it is concerned, I tend to overlook a lot of the detail and try to create an attitude towards plants and bush and animals and creatures ... an appreciation for the environment rather than for specific details about perhaps what a certain thing eats ... or how big it grows or other details. If they have got some appreciation for it they will go on in later life and take an interest in the bush and the rivers and all the creatures that live there."
>
> [intermediate teacher]

Some teachers have no clear goal which they can state explicitly,

41/7/3

> "I don't really know what I hope for them to have (at the end of the year) ... not being really acquainted with the science scheme."
>
> [intermediate teacher]

27/2/1

> "I don't think it would have satisfied any inspector ... if they had come in. I'm pretty sure that they would have said "well, what are your aims?" and I would have sort of gone ... (waves hands in the air!)"
>
> [intermediate teacher]

Perhaps many of our content oriented teachers have never really clarified their goals.

35/6/2

> "Often our teachers have come through the University and they have gained a degree and in quite a few cases they have a fairly sound body of knowledge or facts ... then they go into the classroom and what do they do ... they regurgitate facts ... and they have never sat down and thought out why they are in the classroom and what they are trying to do (what about syllabus intentions?) most teachers don't read the intentions they regard it as guff."
>
> [secondary science inspector]

Finally some teachers have goals which are possibly best left unstated,

15/2/3

> "Physics in the fourth form was all out of a textbook ... you just read and hoped that you understood it. (Where was the teacher?) Just sitting up the front. (Why was that?) I guess it was because we didn't have the equipment to try things out ... I am not sure. (What about her knowledge of physics?) Hm ... that might come into it too (laughter) she was mainly a biology teacher and we did a lot of biology ... we went out and collected insects and stuff."
>
> [ex-pupil]

Perhaps the teacher's role or perceived role depends primarily on whether the teacher sees himself or herself as a developer of scientific knowledge and scientific skills in children or as a developer of children's experiences, knowledge and skills through science, i.e. whether science or the learner are central to the exercise? Many of the earlier quotes in this paper could be easily categorized according to this dicotomy. Traditionally many secondary teachers at least have been concerned primarily with 'science'. However certain comments which have been made to us suggest this is not always the case,

6/12/2

> "One of the things I think more and more about, is that at junior levels (F3 and 4) we should be trying to educate kids through science not trying to teach kids science as science."
>
> [secondary science advisor]

25/17/3

> "I plan my year's work in terms of what I know about the kids in that particular class ... in terms of what I think the kids will be able to do."
>
> [HOD Science]

Many questions about teachers goals and roles are opened up by the comments detailed here. What proportion of teachers have clear overall goals in teaching science? What factors result in a teacher adopting particular goals? How do teachers perceive their role (e.g. nursemaid, advisor, tutor, lecturer, manager, or examination coach)? How does this perceived role relate to the teacher's own goals? How does it relate to syllabus goals? It is interesting to note that not one teacher we talked to explicitly referred to the official syllabus in connection with his or her own goals.

THE KNOWLEDGE AND ATTRIBUTES OF THE TEACHER

Let us first consider comments which have been made to us about teachers' knowledge of science,

63/1/1 "(Many F1 and 2) teachers haven't had (any training in science) since the fourth form so they are coming into something with a lot of fear built into it."

[primary school inspector]

35/10/1 "Let's look at teachers very, very closely ... (many) teachers' ideas are very shaky ... they don't understand the things themselves and they don't understand that everyone of our theories is an attempt to explain what has been observed."

[secondary science inspector]

58/10/3 "The teachers themselves were struggling in most cases (with concepts)."

[secondary science inspector]

Teachers' knowledge in science appears to be a problem both at the Form 1 and 2 level and at the Form 3 and 4 level but for different reasons. At the Form 1 and 2 level teachers have little or no background in science while at the Form 3 and 4 level science teachers do not have a background in all the science subjects that they teach.

42/12/2
38/1/1
17/5/2

27/1/1 "At Teachers College you tend to take subjects that are going to get you through (TC) rather than subjects that are going to make a better teacher ... because Science never was one of my strengths. I cleared right away from it and took social studies which I was good at .....

27/7/1 (For example) I just know absolutely nothing about any basic concepts of electricity ... well that's pretty scary to think well here I am in charge of a class and you know there are so many of us who have slipped through ... and we really are not equipped in that area to be teaching."

[intermediate teacher]

41/1/2 "The unit we are going on to now about mixtures ... I'm dreading ... solutions and solvents and all that ... because I know nothing about it."

[intermediate teacher]

26/4/2 "I am a biologist and my physics is rather weak ... I feel I need time and resource materials and help from a physics minded person to help with that topic."

[secondary teacher]

18/1/2 "In particular areas where I found I had shortcomings in my own understandings I left them to their own devices."

[secondary teacher-chemist]

17/12/2 "A lot of problems I feel (lie in the fact that) kids develop a dislike for a subject purely because the teacher who has been taking the subject has not been sufficiently specialized to handle the subject properly."

[experienced secondary teacher]

61/9/2 "(Intermediate school science would have been better) if they had had properly trained teachers like (when I was in F1 and 2) they just had any old teacher teaching science ... yea they just did what it said in the book ... I suppose they didn't really understand."

[3rd form pupil]

40/9/2 Particularly where the concept should not be difficult for
41/13/2 the teacher to acquire, the real question in F1 and 2 science may in fact be,"is the problem really a lack of knowledge or is it rather the associated lack of confidence?"

39/2/2 "I learned with the children ... I did some research beforehand and made sure I knew it ... but it is one thing to read it in books and another thing to find it actually does happen. ..."

[intermediate teacher]

39/9/3 "It's a matter of getting over saying to the kids 'I don't know what it is, lets bring it back and we will
39/7/2 try to find out' - confidence is a very important quality to develop in teachers."

[intermediate teacher in charge of science]

63/2/1 " ... the kid's reaction to that situation was not what the teacher wanted, but he had got sufficient confidence to be able to say 'I wonder what could have caused this?' and there was a very good development of thinking and of possibilities and ... 'now how can we test which of the ideas is the soundest?' ... now this was a F1 group but this happens very, very rarely."

[primary inspector]

41/25/2 Of course lack of knowledge must be compensated for not only by a confidence but also a positive attitude to science and science teaching.

41/3/1 "I think you have to be an exceptional teacher to get science across, I reckon, because basically it has always been boring to me ... it's always been really boring you know and you have to be really on the ball ... or really enthusiastic yourself to get it across."

[intermediate teacher]

42/13/3 "It was just really terrific. The kids found it absolutely fascinating and so did I."

[intermediate teacher]

But without the knowledge in the subject it is not easy,

41/13/3 "They were keen but I think their enthusiasm sort of dampened a bit when they came up and asked me what something was ... what's another way of doing this and you know you couldn't really explain it. The only way to do it is afterwards go to ... (teacher in charge of science) and say 'well how would you do it?' ... you find out for next time but its not helping these kids is it?"

[intermediate teacher]

42/13/2 "I just wish I had a little bit more background to extend (the bright children)"

[intermediate teacher]

73/3/3
7/4/2
8/4/1 Knowledge, confidence and enthusiasm - what other attributes must a teacher have? Many pupils and ex-pupils talked to us about sensitivity, or lack of sensitivity, of teachers to their pupils' needs,

43/11/2 "(In Form 3) when we were working he used to come and sort of look and that sort of thing ... and if we did it ... say if we asked him a question, he'd show us how to work it out and then he would give us another one to do and we could work that one out, see on the same basis ... (but the teacher we had in Form 4) he put us into groups ... he came around and then called us idiots if we got it wrong, sort of thing."

[ex-pupil]

8/4/1 "a good teacher has a sensitivity to the pupils' needs ... how do you develop sensitivity? ... you obviously have to talk to kids otherwise you don't get the feedback."

[secondary teacher]

18/4/1 Some inspectors, science advisors and experienced teachers have commented on the particular need in science teaching for good managerial skills and good control. A Head of Science commenting on young teachers stated,

25/21/3 > "their management skills are not particularly good, I don't think - the actual techniques of managing a group of kids for an hour to do a particular task."
>
> [HOD Science]

That comment is very similar to the following comment about primary teachers,

84/4/3 > "Some teachers who have a reasonable technical knowledge have difficulty with management and control in situations (that) encourage children's initiative and encourage children's participation ... they are not able to organise the class so that there is on-task development ... it is an educational management worry rather than a concern for the actual techniques used."
>
> [primary inspector]

Again this brings us back to the conflict between what the teacher would like to do and what he or she feels can be done in practice.

25/14/3 > "This is only my third year out, and I had a bit of a chequered career earlier, and I haven't felt too confident about branching out past what I felt I could control reasonably well ... with the fourth form what I did was more dictated by the need to control them rather than the need to teach them ... at first anyway ... so I found that I tended to stick pretty closely to a situation where everyone was doing the same thing so I knew that if someone was doing something different, it was likely that they were playing up ... but of course that creates its own problems."
>
> [secondary teacher]

There is much more to successful teaching than the knowledge skills and sensitivities mentioned so far. Clearly aspects such as resources, syllabus, classrooms, topics, methods and specific objectives, also play an important part in teaching science. However their role falls outside the focus of this paper. What is clear is that a sound background knowledge, an enthusiasm both for science and for the development of children, and an ability to manage and control children in a variety of activities, and to be sensitive to their needs, are important components to

good science teaching.

Central to all these issues is the training teachers receive, and in the next sections we will consider this topic.

THE INITIAL TRAINING OF TEACHERS

Many people we have talked to commented on pre-service training in terms of teaching science. F1 and F2 teachers and primary inspectors commented on what they considered were limited opportunities that many primary teacher trainees receive at Teachers College to prepare themselves to teach science.

63/1/1 "One of the great problems as I see it is the lack of training (in science) of the teachers. I would think 80% (of teachers trained at a certain college) had no science at all."

[primary inspector]

42/11/1 "I didn't do science at Teachers College. I really think it should be a basic part of your training."

[intermediate teacher]

One of the major problems relates to the practice in at least one, if not all Primary Teachers Colleges of training semi-specialists and as a result many student teachers leave with a limited preparation in science.

9/9/2 "You chose subjects (at Teachers College) that you were better at, because you had to pass. So I chose Science and Phys.Ed. because I thought I might struggle with Music to pass it and I thought I might struggle with Art to pass because I am useless at art. But that is really stupid because I had a background knowledge already in Science and Phys.Ed. ... as an all round person it would have been better for me to have taken Social Studies and Art to be able to teach those subjects when I went out ... but they (Teachers College lecturers) put pressure on you to take the subjects you were going to pass in ... and I can't see the point unless you are going to have specialist teachers ... it is strange to me because I came out not having touched, or looked, or having anything to do with, Social Studies and then there will be another hundred or so people who couldn't do science."

[intermediate teacher]

This policy is in direct conflict with the situation that we have observed in schools where some principals require teachers to teach all subjects.

9/8/3
42/17/1

The other comment refers to whether student teachers should be taught method or content. For example:

41/12/2

> "we had a term and a half crash course in science ... some of it was valuable but a lot of it was irrelevant ... like having lectures on the solar system and that ... admittedly it was giving us more information but it wasn't really helping us with the teaching of science."
>
> [intermediate teacher]

Even when science is taken as a selected study there is sometimes problems:

38/1/3

> "I don't think (in science as a selected study) that they gave me the background that I needed to teach science ... if they did I certainly can't remember it ... I don't remember a lot coming from those courses actually as far as teaching science in school is concerned."
>
> [intermediate teacher]

Undoubtedly it is easy to blame one's training, and some of the comments we received may be extravagant. However unlike most topics we have had comments about, when it comes to teacher training related to F1 and 2 Science, we have no really positive comments to report.

18/4/3

Secondary teacher training did receive some positive comments from those we interviewed,

17/11/2

> "I do feel that the best teachers are those that have been trained as teachers ... trained both at University level to get the knowledge and training college level to get the experience handling pupils ... I think this is essential."
>
> [experienced secondary teacher]

23/14/3

> "A lot of people complain too much about Teachers College ... I found it quite useful. I enjoyed my time there[2] ... I think everyone who is going to be teaching should have some training ... I don't know what I would do to improve it."
>
> [3rd year secondary teacher]

[2] One year postgraduate diploma course (Div C.)

Nevertheless we also received negative comments about secondary training too: there is a "lack of attention to lesson planning"; there is a "lack of training in how to get kids to think"; "students are not trained to explore the learner's point of view"; teachers college needs to give "priority to ways of presentation"; students should be taught explicitly about 'the scientific method'; students should spend more time thinking about 'management systems'; 'more time thinking about why they are teaching science in the first instance', and so on. No doubt it would be difficult to meet all criticisms in any one course! And then there is always the problem of not knowing one's future needs anyway,

6/13/2
6/19/2
8/3/2
23/15/2
20/14/1
25/21/2
25/22/2

> 22/9/3 "well I don't think one gets very much out of teacher training if you have never taught before, you don't know what you want, you don't know what you need, you don't know your weaknesses ... I think it would be rather good if there was a 6 month section right at the beginning."
>
> [3rd year secondary teacher]

Naturally there were comments relating to the weak background of many science teachers in their non-specialist subjects,

> 20/13/1 "Well I am amazed that Universities have gone on oblivious to the fact that the biggest single group of graduates that they produce are secondary school science teachers and they still go on producing solely their physicists, their chemists and their biologists and they make no attempt to recognize that since the early 50's the subject in schools has been 'general science' through to SC level. Schools are faced with the situation that they employ a biologist or a chemist or a physicist and they have to make such people into general scientists ... so they teach up to SC level in disciplines that they have had no training in themselves probably beyond 6F level ... I do think that there should be papers or something offered on the teaching of general science at the tertiary level."
>
> [HOD Science]

As the first year of teaching is a part of initial training what particular problems do beginning teachers have? First the problem of loneliness,

22/11/2

> "I didn't know if I was doing things correctly ... you feel very much on your own in the first year."
>
> [3rd year secondary teacher]

18/5/3
23/15/1
21/13/2
17/24/1

and there are considerable difficulties in preparation, finding the resources available in the school, of finding the right level at which to teach, and worrying about control.

25/20/1

> "They need help with sorting out what resources are available, how you might use them, who they are appropriate for, that sort of thing. And they need a lot of help with just being aware of what's happening in their classrooms ... the clues that you get from behaviours and the things that kids say ... that open up all sorts of teaching opportunities and learning possibilities for them."
>
> [HOD Science]

SUPPORT FOR THE TEACHER

Once a teacher has completed the initial training period what sort of support is available to the teacher so that he or she can overcome problems and develop as an increasingly effective teacher?

9/16/1
41/10/3
23/11/3
38/14/2

Many teachers have commented on the support they receive from colleagues,

> "(where do you get information from?) before anything else other teachers because they are always a good source of information."
>
> [intermediate teacher]

23/15/2

> "the other teachers give you advice about what they use."
>
> [3rd year secondary teacher]

However the amount of colleague support is undoubtedly variable from school to school.

42/13/1

> "(This school) has got the right atmosphere (so) that if you need help, you are not scared to sort of yell and admit that you don't know anything about the subject ... because I have been in schools where you have to sort of run around and find somebody and take them away and say very quietly, 'you know I don't know how to do this, can you give me a hand?' "
>
> [intermediate teacher]

27/4/3
9/10/2

Also many teachers have stressed the importance of support from senior teachers and Heads of Departments,

17/5/2

> "It comes back to the ability or the conscientiousness of the HOD to help out the staff."
>
> [secondary teacher]

What sort of support should resource teachers in science

6/5/2
35/3/3
20/9/1

and HODs give to teachers? Comments have been made to us about the need for these people to provide schemes for teachers, to provide resources, to integrate schemes with equipment, to organize textbooks, and to provide encouragement to young teachers.

8/9/2

> "HODs should be looking at young teachers and how they are doing in the classroom and they should be encouraging teachers and telling them they are doing a good job because nobody else will do it."
>
> [HOD Chemistry]

41/18/3
6/11/2

On the other hand some have suggested it might be possible to give too much support.

39/1/3

> "You can do so much for teachers and I think sometimes we do too much ... If they are not prepared to get in and do so much for themselves the thing is never going to fire."
>
> [senior intermediate teacher]

Colleague and HOD support provides a mechanism whereby a teacher can seek help about immediate teaching problems. However what informal and formal mechanisms are available for continued

professional development in science teaching?

17/3/3 It would appear that in general teachers see their job as a lonely one and their are few opportunities for teachers to share ideas and learn what others are doing even on an informal basis.

8/12/3 "You are very much isolated in teaching ... you thing you are in a people factory but you are all by yourself."

[secondary teacher]

79/3/2 "I don't know what the hell they actually do in other F2 classes if they take science or whatever."

[F2 primary teacher]

17/3/3 "I have never ever seen an intermediate class in action ... maybe I should take time off to go to see (what is being taught and how it is being taught)."

[HOD Science]

It seems to us that the value of teachers being able to share ideas and see how others teach should not be underestimated,

83/7/2 "we worry about what we teach but I think that there is an awful lot of things we could help each other with ... how we teach type of thing ... not so much the syllabus but the ways of getting information over to the kids."

[F2 teacher in F1-7 school]

Undoubtedly, the opportunity to learn how others teach can really influence teaching,

8/13/2 "there was an innovation I had not even considered ... not even heard of before ... and (now) here I am doing it."

[experienced secondary teacher]

35/3/3
26/4/3
27/7/2
9/4/2
64/7/2
C4/8/2
72/4/2

Comments have also been made to us on the lack of in-service courses and formal opportunities for continued professional development in science teaching. Many of the needs that people have identified relate to issues already raised; improving background knowledge; learning of new and different methods

79/4/1 of identifying objectives, methods of teaching and methods of assessment; becoming familiar with new syllabuses, new equipment and so on.

8/12/2
35/3/3
27/3/3 A wide range of courses have been suggested to us from high powered University courses in science education to courses related to specific problems in specific schools. We have had a number of comments about school based courses run by local science advisors on specific issues of immediate concern,

6/16/1 "It is no use dragging people off to in-service courses out side the school. You have got to help the schools help themselves ... make them more aware within their own environment."

[secondary science advisor]

9/4/2 "I think the school based courses that are supplied are good but I don't think enough teachers get them ... If many of the schools are like our school (only) the permanent staff get the courses ... It is not good for the poor 2nd, 3rd and 4th year teachers who are still flitting from school to school."

[intermediate teacher]

63/6/1 "I gave them three relievers, they were able to release five additional teachers because of manual training classes and this way the science advisor had eight Form 1 teachers for the whole day ... they studied a unit they were about to teach and at the end of the day (the teachers) went back to their classrooms highly charged. They were very, very thoroughly motivated."

[primary inspector]

73/7/3 "The advisors come in and run in-service courses on the next unit we are going to teach ... its a day course intra-school and the information involved in those courses is beneficial for the teachers but the actual concept of the unit itself and how to teach it never gets off the ground because the advisor has got so much in terms of content that he is trying to teach."

[intermediate teacher]

38/8/2 The necessity for courses to be seen to be relevant to fairly immediate teaching needs is well known.

38/8/3

> "The science advisors ran a couple of courses but from what I remember it was mainly an experimental thing where you did things yourself but you didn't really get a lot out of it ... again you didn't ask yourself why you were doing it ... what relevance it had to you ... I don't think they were actually related to what we were going to be teaching in the coming weeks."
>
> [intermediate teacher]

Comments have also been made on the need for courses for more senior teachers,

84/3/3

> "To me one of the problems is training people (in a school) to administer a curriculum area. To be able to communicate effectively, to be able to give some assistance and support with the planning of science rather than hoping (to be able to) give some support in terms of building up the equipment and using the equipment. To make sure that there is some current knowledge and status of science in the school at all times. In other words giving some valuable assistance which crosses classes, which results in some feedback so that science can be monitored across the school."
>
> [primary inspector]

6/5/1
6/11/3

> "the biggest fault among HODs is that they do not have any managerial experience ... and what they give teachers to plan from is too minimal."
>
> [science advisor - secondary]

In summary, teaching is a lonely job and there is in general insufficient opportunity for teachers to share ideas and learn about what others are doing. Teachers have suggested to us that they learn best by specific concrete examples and if this is so, more opportunity needs to be provided for teachers to observe others teaching in the same school, in different schools, at the same level of teaching and at different levels of teaching. This will not only involve time, organization and to some extent, finance, but also it seems a change of attitude on the part of many teachers to be at ease with others in their classes as much as anything else.

8/12/3

And what is the role of the science advisor? One teacher's view was, that they should lead by example,

73/8/2

> "I would much prefer the science advisor to come in and say 'I will help you with your radiant energy lessons this term' ... he might have a set of lesson plans - I don't know ... if he presented you with a set of plans and then said 'look, I'll do the first two lessons and we will see how it goes and we'll talk about it afterwards ... that would be far more beneficial than to run a course and to say this is how it should be done."
>
> [intermediate teacher]

Is this the role of the science advisor? Is this practical? Is this something that should be done by the HOD or science resource person? Is it spoonfeeding? These are some of the questions that need to be answered.

COMMENT

In reconsidering the issues raised in this paper there are many problems and difficulties which could be resolved if more money and more manpower were available. Largely these are economic decisions and we do not wish to discuss them further here. Rather we wish to consider the extent to which some of the difficulties might be alleviated without great manpower or financial input.

To us a central question which teacher and pupil comment raises is "Are we using the human resources and expertise which we have in our schools in the most effective way possible with respect to the teaching of science.' In terms of teaching science to pupils we would suggest the answer is clearly 'no'. We have teachers in a school, teaching aspects of biology, chemistry and physics who know little or nothing of these subjects while there are other teachers in the school with expertise which is not being fully utilized.

In terms of developing pupils through science the answer may or may not be 'no' and perhaps this needs to be considered more carefully. What are principals gaining at the intermediate

school level in insisting that teachers should be generalists compared with what is being lost through the lack of teacher expertise in particular areas? Does the transient population of intermediate schools discourage specialisation or does the generalist role result in transience? What is clear at the intermediate school level, is that the current discrepancy between school organisation and teacher training practices needs careful reconsideration.

25/8/1
16/3/2
18/1/1
25/20/2
15/2/2

At the F3 and 4 level on the other hand, very careful reconsideration needs to be given to what is really being gained in insisting that one teacher should teach all aspects of science without adequate training in each of them. Undoubtedly what students know about a particular science subject and their attitudes towards it are influenced by the teacher's specialist background in all sorts of ways, some of them quite subtle;

36/2/3

> "He used to say ... 'I hope you understand this, this is sixth form work and it will really help you when you get to the sixth form' and we felt really big and important because here we were doing sixth form work."
>
> [ex-pupil about F4 science]

Is it surprising that physics graduates, all of whom will be competent at mathematics, prefer to teach mathematics to F3 and 4, rather than science. In science they have no specialist background for up to two-thirds of the programme. What would be lost and what be gained by physicists only teaching the physics topics in a science programme?[3]

The second major question which we believe this paper raises is 'Are we giving enough attention to finding possible ways of encouraging professional development through the sharing of teaching experiences and subsequent discussion?'

Can the physics specialist in a school really help the junior science teacher in teaching physics if he is not a regular visitor

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[3]Perhaps the opportunity to do this might attract them back from teaching mathematics!

to the junior science classroom? Is he encouraged to give up his free period to visit such classes? Do, or should, the junior science teachers encourage such visits? How can the biologist specialist be encouraged to take a demonstration lesson or two with the chemistry specialist's 3rd form science class? Should science advisors tell or show teachers how to teach? How do we create an environment where people can move freely into and out of each other's classroom and into and out of each other's school; where advice can be asked and given without people making value judgments?

If the way we have been given open access to so many classrooms is any indication, the changes we suggest are not too extreme.

Do you consider the issues and questions we have raised in this paper important and central to Form 1 to 4 Science? Bearing in mind that the Learning in Science Project is particularly concerned with concepts, process skills and attitudes of the learner what can or should the Project do, if anything, with regard to the problems and difficulties we have mentioned? We would appreciate your comment.

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